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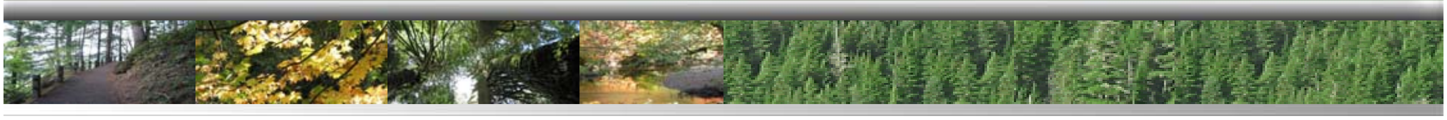

The FORSight Resource

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Managing Timberland Under Price Uncertainty

A Case for Tactical Planning

In today's competitive world, forest landowners face the prospect of developing a forest management plan and managing their land while experiencing volatile timber prices. Integrated forest products firms which have commitments to supply volume to their own mills may consider this to be price risk. Non industrial private firms and individuals can use this price volatility to manage their lands to capture additional economic profit while still ensuring that they follow the best long-term strategy for their timberland holdings.

In order to understand the impact of this price uncertainty on profitability, a set of strategic and tactical plans were built for a hypothetical southern pine forest. This simulated forest totaling 158,971 acres was classified into the following stand conditions: 117,496 acres of pine plantations, 22,055 aces of natural hardwood, 15,758 acres of natural pine, 2,181 acres of site preparation, and 1,481 acres of cutover.

The strategic and tactical plans were developed using a linear programming optimization model (Model II formulation). Several assumptions were common among these models. With regard to harvests, thinning was permitted between age 14 and 20, and final harvest was allowed on stands 20 years of age or greater. Establishment treatments included site preparation, planting and herbaceous weed control. Fertilization was allowed at 5, 10, and 15 years of age, and was required post thinning. The objective was to maximize net present value using an 8% real (net of inflation) discount rate.

Two prices scenarios were used in the analysis. Scenario one used the first 20 years worth of historical annual price data to develop a 100-year linear price trend for pine sawtimber, pine chip-n-saw, and pine pulpwood. The second scenario used 10-years of additional historical price data, but then returned to the linear price trend for the remaining 90 years (Exhibit 1). All timber prices were real (net of inflation). Hardwood sawtimber and pulpwood prices were held constant over the entire planning horizon.

In order to examine the impact of implementing tactical price response strategies, 3 separate cases were run. The

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Harvest Scheduling Model Formulations

Stumpage-Price or Delivered Price?

When we meet with a client to discuss the details of a harvest scheduling modeling project one of the first questions we ask is, "What are your objectives?" Most often, the answer is to maximize the value of discounted future cash flows. In these cases, the next question is, "Do you want a stumpage- or a delivered-price model?" While the answer clearly has implications for the model-building process, there is a more fundamental question being asked about their management goals that many clients apparently have not fully considered. So, let us explore this issue more fully, first delving into the mechanics of building these kinds of models, and then we will discuss the implications for managers. Of the two, a stumpage price model is the more common,

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Upcoming Events...

WINNING TECHNOLOGIES IN FORESTRY 2007
Real World Answers for Real World Problems
World Forestry Center,
January 18-19, 2007, Portland OR

SOFEW 2007
March 4-6, 2007 San Antonio, TX
http://sofew.cfr.msstate.edu/

Decisions for Sustainability:
Forest Estate Models for the Future
June 12-14, 2007
Victoria, BC
http://www.femc2007.net

SAF National Convention
Oct 23-27
Portland, OR
http://www.safnet.org/natcon-07/Save_the_date.pdf

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and easier model to formulate, so we will start there.

In a stumpage price model, the prices for various products represent the average value of timber, net of harvesting and hauling costs, and other costs such as severance taxes levied at the stump. For example, suppose a nearby mill pays $350/MBF for conifer saw logs delivered to the gate. If it costs $120 to harvest 1 MBF, $80 to haul 1 MBF to the mill, and the state imposes a severance tax of $2.50/MBF, the net return to the landowner is $147.50/MBF.

If there are multiple mills in the area with various hauling distances, a weighted average stumpage price can be determined for each product. There may also be different stumpage prices depending on whether the timber is produced via thinning or final harvest. And, if the forest estate being modeled is large and geographically diverse, stumpage prices may be assigned at the tract level, representing logical assignments of logs to the nearest mill to minimize hauling costs.

While stumpage represents the revenue side of the equation, silvicultural treatments provide the costs: site preparation, planting, herbaceous competition control, fertilization, precommercial thinning, pruning, etc. The decision variables in a stumpage model determine whether an activity (e.g., fertilization, commercial thin, final harvest) is carried out, and when and where it is implemented on the forest. These decision variables trigger revenue or cost outputs. In the objective function, the discounted silvicultural costs are subtracted from the discounted harvest revenues to yield the net present value of future cash flows.

In a delivered price model, the prices for various products represent what a particular mill pays at the gate (e.g., $350/MBF from our previous example). If there are multiple mills to consider, each may have a unique price for each product it buys. Moreover, the hauling distance to each mill will similarly be unique and therefore will have a unique, associated hauling cost. At the stand level, harvesting and silvicultural costs are not affected by the decision to send products to any one mill. These costs are applied in the same fashion as in the stumpage model. In the stumpage model, the destination for products is predetermined; in the delivered price model, the destination for products is part of the decision.

For example, in a stumpage model, a decision variable may represent a clearcut harvest in period 1, yielding 100MBF of timber, and a revenue of $147.50. In the delivered price model, there may be multiple decision variables, all with the same 100MBF yield, harvest cost and severance tax coefficients, but with different hauling cost coefficients. Because the revenue coefficient in the stumpage model is an average, the net revenue generated in the delivered price model for that same stand may be quite different.

Delivered price models can get very complicated, depending on the number of products, mill destinations, and how detailed one gets calculating hauling costs (e.g. stand-level vs. tract-level). Remsoft's Allocation Optimizer extension to Woodstock is designed specifically to address complex, delivered price models.

So, let's go back and look at the decision variables again. What does it mean from a managerial perspective to prefer a stumpage model over delivered price? Aren't you really just answering the same question? The answer is NO!

Dapples. Mt Rainier National Park
Photo courtesy K.R.Walters

In a stumpage model, management is asking "what is the best strategy to manage this **property, as a whole**, to maximize financial returns?" If two stands have the same species, site and stocking, the silvicultural regime to be applied to them is exactly the same, regardless of their location in the forest. The viewpoint is distinctly forest-level, and is typical of large landholders such as integrated forest products companies that historically owned forestland to meet their own mill requirements.

In a delivered-price model, the management question is focused more at the stand or tract-level: "What is the best investment to apply to this **stand/tract,** to maximize financial returns overall?" Consider the same two stands in the previous example, except that one stand is 10 miles from the nearest mill and the other is 80 miles. Does it make sense to invest as much silviculture in the remote stand as the nearby stand? The optimal solution probably suggests no.

So other than for the sake of simplicity, why would anyone choose a stumpage model over a delivered price model? Consider that harvest scheduling models are strategic planning tools, with long planning horizons, and that the most consistent aspect of any planning environment is **change**. Suppose that next year, the nearby mill from the previous example closes, and now the two stands are equally distant from another mill. Would your silvicultural strategy change? With the stumpage model, changes to the silvicultural strategy are not likely to change much at all, but a completely different strategy would probably result in the delivered price model.

Moreover, foresters charged with implementing silviculture typically do not maintain different sets of silvicultural regimes for each forest tract. Instead, they are more likely to use a common set of prescriptions over the entire land base to maximize productivity overall, with the hope of creating more options for selling into a changeable marketplace. After all, a chip-n-saw log can be

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Southern Hardwood Growth Model

	PARTICULARS
Author	Sean J. Canavan
Species	Mixed hardwoods of the southeast
Region	US Southeast
Silviculture	Establishment, Intermediate & Final Harvest Options
Model Type	Dynamic Link Library
Add'l Info	http://FORSightResources.com/biometrics.htm

Hardwood tree species comprise five of the eight major forest types in the US South, with almost half of the country's hardwood timber coming from this region. While typically not as intensively managed as pine species, such a large acreage and volume in hardwoods creates a need for tools to manage it properly and productively. One component of this need is for a model that can reliably predict southern hardwood timber growth and yield through time.

FORSight has developed a growth model for southern hardwood forests. FORSight's hardwood model is a stand-level model based on empirical growth and yield relationships for naturally regenerated mixed-species hardwood stands. The model accepts current stand parameter values such as age, density, and site index along with optional inputs for current stand volume measures and then grows the stand forward for a user-specified number of years.

Starting conditions may be as young as Age 1. Ingrowth is built into the model with the amount based on the input values for site, density and age. Predicted stand volumes are merchandised into three product classes: pulpwood, sawtimber, and top wood. The model has been tested and employed on thousands of acres of hardwood forests in the southern US and has been found to produce stable growth projections that fit with foresters' expectations across a wide range of site, density, and age conditions.

Hardwood model development began out of a need for a tool to predict hardwood growth and yield to support harvest planning models on client's forests. It was necessary for the model to operate using only those stand-level inputs typically collected by FORSight's clients. Projects in which hardwood value is high and tree-level data are available are run in a more sophisticated tree-level model such as FVS.

Thinning routines are now being produced to address additional client needs for more than just grow-only information. At the same time, development is continuing on the model to produce separate versions for upland and bottomland hardwood forests, recognizing the growth and yield differences inherent in those two ecosystems.

FORSight's hardwood model is currently implemented as a dll within a suite of proprietary growth models, allowing for both individual stand and batch processing. As client needs evolve, so will FORSight's skills and toolset for addressing those needs. Continued development and improvement of tools such as FORSight's hardwood model are examples of how this is being done.

To learn more about the Southern Hardwood model, contact Sean Canavan at 360-882-9030 or use our contact page http://FORSightResources.com/contact.htm.

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sold as pulpwood if need be, but the converse is not true.

So which model form do you choose? It depends on several factors but land tenure is a key consideration. If you represent a timberland investment management organization and the forest is being held in a closed-end fund for 10 years, your planning horizon is sufficiently short that events like a mill closure would force large-scale changes to your strategy anyway, and a delivered price model that is sensitive to these types of changes may be appropriate. On the other hand, if you have a long-term outlook and plan to hold land for decades, there is the very real possibility that a new mill could open to replace the one that closed. If the forest has been managed to consistent standards throughout, it is less likely that you will have made a very wrong decision about a particular stand (e.g., high site stand under minimum level management 5 miles from the new mill), than with a delivered price model. Also of importance is the number, and diversity of potential mills to which wood could be delivered, both within your organization, and to outside buyers. Increases to the number of mills available increases the likelihood that there is a mill closeby to any stand/tract, which makes the decisions more similar to a stumpage price model. The final decision is a trade-off between precision at the tactical level versus a more strategic look over the long-term. A final decision can only be reached by clearly understanding the goals and objectives of the planning exercise and with a thorough knowledge of the forest and the markets for wood products in the region.

Managing Timberland...

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first case produced a strategic plan, optimal wood flow and cash flow using the trend prices developed using the first 20 years of historical data (Case: Trend Prices).

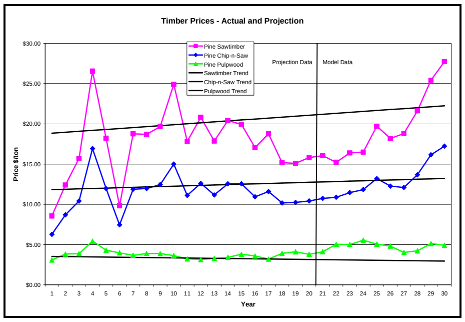

Exhibit 1: Timber price linear trend projection versus actual.

The second case assumed that the owner was a price taker and followed the harvests suggested by the strategic plan exactly (Case: Actual Prices – Trend Strategy). The third case assumed that the landowner had perfect knowledge of the future prices in advance and modified the harvest strategy to reflect this knowledge of future prices (Case: Actual Prices – Re-Optimized). Comparisons of revenue, harvest volume and net present value were made between these three runs.

It should be obvious that the financial results obtained in the third case (Actual Prices – Re-Optimized) will be impossible to obtain. However, it should be easy to obtain the results in the first case (Trend Prices). In fact, it should be possible to exceed these results by carefully applying tactical planning techniques to adjust the plan to the actual market prices.

For landowners with the flexibility to adjust harvest levels, it is likely that the actual results will fall somewhere between the Trend Prices and the Actual Prices – Re-Optimized cases.

As can be seen in Exhibit 2, pulpwood and chip-n-saw harvest volumes for the first 10 years are significantly lower in the Re-Optimized case. Since prices for these products were lower throughout most of this period (years 21 through 30), harvest levels are reduced. However, sawtimber harvest levels are higher. This is especially noticeable in period 5, and periods 8 through 10 where sawtimber prices are higher. The overall harvest level is only two percent lower in the Re-Optimized case and thus the basic intent of the strategic plan is maintained. By leaving the stands to grow slightly longer more sawtimber harvest is obtained.

	Pine Pulpwood			Pine Chip-n-Saw			Pine Sawtimber		
Year	Trend Prices	Actual Prices Trend Strategy	Actual Prices Re-Optimized	Trend Prices	Actual Prices Trend Strategy	Actual Prices Re-Optimized	Trend Prices	Actual Prices Trend Strategy	Actual Prices Re-Optimized
1	149,667	149,667	95,505	299,153	299,153	204,004	1,290,374	1,290,374	1,022,780
2	93,341	93,341	345,169	199,208	199,208	537,423	1,272,725	1,272,725	307,467
3	252,827	252,827	59,484	432,176	432,176	132,587	723,745	723,745	878,983
4	372,977	372,977	734,495	602,765	602,765	208,512	292,131	292,131	20,941
5	263,821	263,821	45,439	558,013	558,013	96,828	319,251	319,251	961,892
6	346,370	346,370	373,205	394,288	394,288	447,510	286,318	286,318	173,028
7	427,692	427,692	282,733	351,195	351,195	428,378	145,392	145,392	183,258
8	233,097	233,097	109,883	229,806	229,806	302,713	368,948	368,948	660,646
9	281,778	281,778	113,536	219,192	219,192	316,342	247,696	247,696	858,014
10	284,967	284,967	63,541	114,135	114,135	121,645	274,696	274,696	973,917
Total	2,706,536	2,706,536	2,222,989	3,399,930	3,399,930	2,795,942	5,221,277	5,221,277	6,040,927

Exhibit 2: Timber harvest levels for three price scenarios

	Total Pine		
Year	Trend Prices	Actual Prices Trend Strategy	Actual Prices Re-Optimized
1	$ 28,363,552	$ 24,538,536	$ 18,999,141
2	$ 26,811,303	$ 22,008,700	$ 12,266,463
3	$ 19,838,237	$ 18,074,331	$ 16,215,196
4	$ 14,119,046	$ 14,011,315	$ 6,880,907
5	$ 13,781,682	$ 14,993,143	$ 20,466,952
6	$ 11,506,931	$ 11,705,281	$ 10,427,247
7	$ 8,556,639	$ 8,700,699	$ 9,763,380
8	$ 10,838,157	$ 12,107,760	$ 18,894,606
9	$ 8,522,873	$ 11,273,503	$ 27,485,810
10	$ 7,817,653	$ 10,985,924	$ 29,415,271
Total	$ 150,156,073	$ 148,399,192	$ 170,814,973

Exhibit 3: Harvest revenues for three price scenarios.

As shown in Exhibit 3, revenues are slightly lower for the Actual Prices – Trend Strategy case. The 10-year average prices from the trend strategy are actually lower than the 10-year average actual prices for all three products. But as a price taker who is following a set strategy and not altering harvest in response to the actual observed prices some revenue is lost (approximately 1% lower).

However, if future prices are known with certainty, increased timber revenue can be obtained (14% higher).

A landowner who has developed a strategic plan and then follows it exactly even while prices are changing will generate substantially lower returns. In the example used here, returns were 5% lower over the first 10 years and 3% lower over a 50 year period. However, if perfect knowledge of future prices is assumed, then the landowner could generate 6% higher returns versus the Actual Price – Trend Strategy case over the first 10 years and 3% higher returns over a 50 year period.

Years	Trend Prices	Actual Prices Trend Strategy	Actual Prices Re-Optimized
1-10	$ 92,711,256	$ 88,135,658	$ 93,467,516
1-50	$ 136,116,481	$ 131,540,883	$ 136,034,948

Exhibit 4: Net present values for three price scenarios

So, how can a landowner use this information to improve returns off of their timberland, since no one can know future prices with certainty?

First, it is important to have a long-term timberland management plan in place. This plan sets overall strategy for timber management and will be used as the basis for tactical adjustments to the plan. This plan should be developed using a long-term forecast of future prices and should not use current prices as its starting point since this may be significantly above or below the expected prices for the long run. In this example, we used a simple linear trend developed using the past 20 years of actual prices for each product. This example also assumed that prices are mean reverting and will return to those trend prices over time. In any case, the landowner must have some viewpoint on the direction of future prices with which to develop the strategic plan.

The landowner should then monitor current prices and make adjustments to their strategic plan to take these current prices into account. For example, if pulpwood prices are currently lower than the trend price and

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sawtimber prices are currently above the trend price, then the landowner should focus their harvest on stands with higher proportions of sawtimber. Conversely with low sawtimber and/or chip-n-saw prices and high pulpwood prices a landowner would focus his harvest on thinning stands with higher pulpwood proportion. If all of the actual prices are below trend prices the landowner should lower overall harvest levels and wait for timber prices to improve. Finally, if timber prices are higher than trend prices the landowner should harvest higher than the strategic plan might suggest, thus capturing the excess stumpage prices that are temporarily available.

Care should be taken when making adjustments to the strategic plan. First, volume harvest should not be allowed to stray significantly from the strategic plan over the long term. For example, we may wish to force the tactical harvest level to equal the level set by the strategic plan over some set period, perhaps 5 or 10 years. Second, unless there are major structural changes to the prices, the silvicultural elements of the plan should be adhered to strictly. For example, if the strategic plan suggests fertilization and herbicide treatments are optimal, we should continue to implement them even if current prices would change our decision. After all, we are still believers in our long term price assumptions.

Many industrial forest landowners do not have the flexibility to implement these types of tactical adjustments to their strategic plan. They have specific volume requirements in order to ensure a continuous supply of wood to their mills. and in times of low timber prices they can often find themselves financial difficulty. In response to these financial concerns they typically increase the harvest off of their fee land holdings in order to minimize cash outflow. This is exactly the opposite tactic from what they should do to maximize returns from their timberlands, but it facilitates the implementation of these tactical price response strategies by other private timberland owners.

Overall, implementing such a strategic plan with tactical adjustments should allow private landowners to achieve incremental profits from management of their land holdings.

FORSight Resources provides world-class expertise to companies and agencies facing critical natural resource decisions. The company's offerings include forest planning, acquisition due diligence, forest inventory &biometrics, GIS & data services, custom system/application development and hardware/software sales.

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Strategic Implications of Clonal Plantation Deployment

Bruce Carroll, Rafael De La Torre and Eric Cox. 2006

Abstract - After years of development, elite varieties of clonal seedlings are becoming commercially available to industrial forestry companies and timberland investment management organizations. Forest managers now must consider the strategic implications of their deployment on their timberland holdings, particularly how deployment and future growth of clonal seedlings will impact the management strategy for their timberlands.

Where forests are managed with harvest flow constraints in place (e.g., wood supply agreements), immediate increases in harvest rates can be achieved through intensive forest management that increases growth rates – the so-called "allowable cut effect" (ACE). Deploying fast-growing elite clones should have similar effects. Understanding the magnitude of ACE attributable to clonal seedlings, and carefully managing the transition may create important strategic advantages.

We start with a simulated intensively managed southern forest. Estimates of future expected yields are determined using early growth data from currently-available elite loblolly pine clones. A linear-programming forest model is used to determine the optimal base line management strategy (without clonal deployment). Next, three alternative clonal deployment strategies are analyzed and compared to determine their impacts on financial returns and wood flows. All three of these alternatives are compared to the base case with no clonal deployment. Impacts on wood flow, cash flow, and net present value are determined and presented.

For a copy of this paper, contact Bruce Carroll, President & CEO, or visit our website at http://FORSightResources.com.